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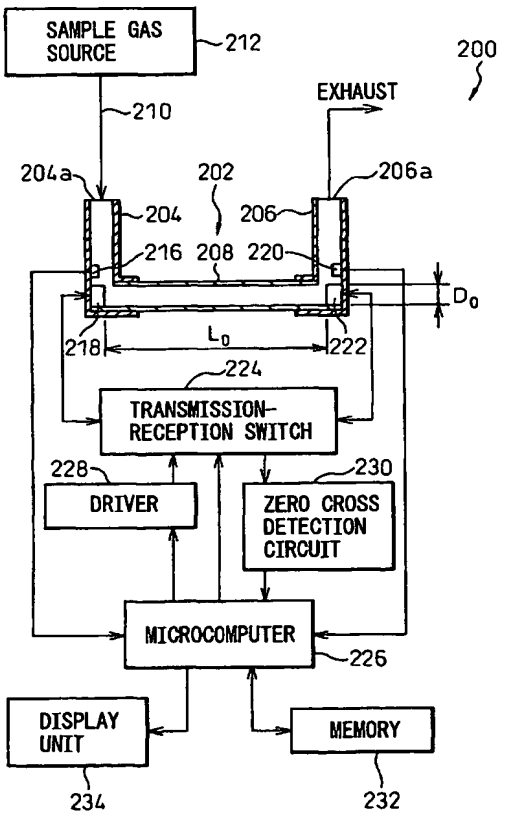
[Continued on next page]

(54) Title: ULTRASONIC APPARATUS AND METHOD FOR MEASURING THE CONCENTRATION AND FLOW RATE OF GAS



(57) Abstract: ABSTRACT An ultrasonic apparatus measures the concentration and flow rate of a sample gas by calculating a possible propagation time range on the basis of the gas temperature, determining whether or not the phases at which two first trigger signals; respectively generated on the basis of forward and backward waveforms of the ultrasonic waves, coincide with each other, processing the zero-cross signals so that the phases coincide with each other, obtaining reference zero-cross time instant by calculating mean value of the forward and backward zero-cross time instants, obtaining an ultrasonic reception point by subtracting an integral multiple of the cycle of the ultrasonic waves so that the results of the subtraction falls into a possible propagation time range and estimating the ultrasonic propagation time on the basis of the ultrasonic reception point.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP2004/005590

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01F1/66 G01N29/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01F G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 052 230 A (STEINACHER MICHAEL ET AL) 1 October 1991 (1991-10-01) column 5, line 16 - column 6, line 49; figures 2,3,17 column 20, line 26 - column 23, line 39 figures 1-3,17,18	1-18
A	EP 1 286 159 A (TEIJIN LTD) 26 February 2003 (2003-02-26)	1-18
Y	the whole document	19-22
A	US 5 123 286 A (BAUMGAERTNER MANFRED) 23 June 1992 (1992-06-23) the whole document	1,7

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 March 2005	26. 04. 2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Politsch, E

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2004/005590

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 0070, no. 38 (P-176), 16 February 1983 (1983-02-16) & JP 57 190281 A (HOKUSHIN DENKI SEISAKUSHO:KK), 22 November 1982 (1982-11-22) abstract	1,7
Y	US 4 325 262 A (MEISSER ET AL) 20 April 1982 (1982-04-20) column 1, line 65 - column 4, line 22; figures 1-5	19-22
Y	FR 2 462 837 A (LANDIS ET GYR ZUG AG) 13 February 1981 (1981-02-13) page 7, line 19 - last line ; figure 5	19-22
Y	EP 0 606 536 A (LANDIS & GYR BUSINESS SUPPORT AG; LANDIS & GYR TECHNOLOGY INNOVATION A) 20 July 1994 (1994-07-20) page 2, line 38 - page 4, line 39; figures	19-22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/005590

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18

These claims concern improved ultrasonic wave propagation time measurement in an ultrasonic apparatus and method for measuring the concentration and flow rate of gas.
The common special technical feature of these claims is the inference of a reference zero-cross time instant from a plausibility check by subtracting an integral multiple from the phase-aligned average of the measured forward and backward propagation time.

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2. claims: 19-22

These claims concern the signal/noise ratio optimization of an ultrasonic concentration measurement apparatus.
The common special technical feature of these claims is the choice of the geometric proportions of the distance between the ultrasonic transducers and the respective ends of the flow conduit dependent on ultrasonic sound velocity, inner conduit radius and frequency.
It is noted that the inequation given in claim 19 is obviously erroneous.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No
PCT/JP2004/005590

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